instructions for controlling said pump system to maintain a pressure of about 1-20 torr within said applicator during said first time period.

19. The apparatus of claim 16 further including a microwave source in electrical communication with said plasma applicator, with said controller being configured to regulate said microwave source, wherein said set of computer instructions further includes a fourth subroutine to be operated on by said controller to regulate said microwave source to direct microwaves into said internal volume of said applicator during said first time period.

20. The apparatus of claim 19 wherein said fourth subset of computer instructions controls said remote microwave plasma system to direct said microwave energy at a power level ranging from about 150-500 W to ignite said plasma in said applicator.

21. A method of removing residue from a substrate processing chamber, said method comprising:

forming a flow of reactive radicals generated in a remote plasma outside of said chamber;

forming a nonplasma gas flow;

mixing said flow of said reactive radicals and said nonplasma gas flow anterior to said chamber to form a gas-radical mixture; and

flowing said gas-radical mixture into said chamber.

REMARKS

Claims 1-21 are pending. Claims 1, 4, 8, and 16 have been amended to correct informalities, and to more particularly point out and distinctly claim Applicants' invention. No new matter has been introduced. Furthermore, the nonplasma gas flow recited in claims 1, 8, and 16 as amended was recited in claim 21 which is unamended, and a nonplasma inert gas was recited in claim 9 which is unamended. Therefore, Applicants believe no new issues have been raised by the amendments and respectfully request entry thereof.

Applicants respectfully assert that claims 1-21 are patentable over the cited references because, for instance, none of the references disclose or suggest a method or an apparatus for forming a flow of reactive radicals, forming a nonplasma gas flow, and mixing the flow of reactive radicals and the nonplasma gas flow anterior to a chamber to form a gas-radical mixture. In the present invention, producing the gas-radical mixture anterior of the

chamber allows increasing the flow rate of a gas through the chamber, while decreasing the rate at which materials located within the chamber are etched by the reactive radicals dispersed within the gas-radical mixture (page 4, lines 15-18). The references are completely devoid of any suggestion for the recited features.

Applicants would like to thank Examiner Zervigon for the courteous telephone interview extended to Applicants' counsel, Chun-Pok Leung, on April 25, 2000. During the interview, the rejections over Kawamura and Moslehi were discussed. The Examiner suggested that a written response be prepared and filed clearly pointing out the differences between the claimed invention and the cited references.

Claims 1-4, 6, 8, 9, 11-15, and 21 Are Novel and Patentable over Kawamura

Claims 1-4, 6, 8, 9, 11-15, and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura (U.S. Patent No. 5,328,558).

Applicants respectfully submit that claims 1-4 and 6 are novel and patentable over Kawamura because, for instance, Kawamura does not disclose mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to a chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber in a method of removing residue from a substrate processing chamber, as recited in claim 1 from which claims 2-4 and 6 depend.

Kawamura has nothing to do removing residue from a chamber, but discloses flowing plasma-activated species of an NF_3/H_2 mixture as a feed gas for an etchant for etching SiO_2 on a silicon wafer. "The NF_3/H_2 mixed ratio of the mixture is so set as not the effect the etching of the SiO_2 film under a chemical action. **Then** the absorbed activated species are irradiated with Ar low energy ions so that the activated species are excited and etch the SiO_2 film." Abstract (emphasis added). In Kawamura, the NF_3/H_2 is activated by plasma and flowed into the chamber. The flow is stopped by closing valves (36) and (38), and then the valve (50) for the Ar gas is opened to feed the Ar gas into the chamber, which is made into plasma by the high-frequency power source (56) and magnet coil (58) to excite the activated species absorbed in the SiO_2 film (col. 6, lines 12-36).

Kawamura does not teach or suggest mixing a flow of reactive radicals and a nonplasma gas flow anterior to the chamber to form a gas-radical mixture. Therefore, claims 1-4 and 6 are novel and patentable over Kawamura.

Applicants further submit that claims 8, 9, and 11-15 are novel and patentable over Kawamura because, for instance, Kawamura fails to teach or suggest means for mixing a flow of reactive radicals and a nonplasma gas flow anterior to the chamber to form a gas-radical mixture, as recited in claim 8 from which claims 9 and 11-15 depend. As discussed above, Kawamura is devoid of any disclosure for mixing a flow of reactive radicals and a nonplasma gas flow anterior to the chamber to form a gas-radical mixture. Accordingly, claims 8, 9, and 11-15 are novel and patentable over Kawamura.

Applicants respectfully note that claim 21 is also novel and patentable over Kawamura because, for instance, Kawamura neither discloses or suggests forming a flow of reactive radicals, forming a nonplasma gas flow, and mixing the flow of reactive radicals and nonplasma gas flow anterior to the chamber to form a gas-radial mixture.

Claims 1-15 and 21 Are Novel and Patentable over Moslehi

Claims 1-15 and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi (U.S. Patent No. 5,403,434).

Applicants respectfully submit that claims 1-15 and 21 are novel and patentable over Moslehi. For example, Moslehi does not teach mixing a flow of reactive radicals and a nonplasma gas flow anterior to a chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber, as recited in claim 1 from which claims 2-7 depend and as recited in claim 21. Nor does Moslehi disclose means for mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to the chamber to form a gas-radical mixture, as recited in claim 8 from which claims 9-15 depend.

Moslehi discloses a digermane-assisted dry cleaning process. For thermal activation, "[t]he halogen-containing gas additive, such as HCl or HBr, is introduced into the basic cleaning mixture of $Ge_2H_6 + H_2$ through nonplasma gas manifold 22 (without any direct plasma discharge activation)" (col. 10, lines 53-56). For a plasma process, the "plasma activation can be achieved by injecting a remote plasma stream using the gases injected through plasma gas manifold 24" (col. 11, lines 29-31). Moslehi injects "a remote plasma stream of H_2, Ar/He (or other inert gas such as He or Xe), or an H_2+Ar/He mixture" (col. 11, lines 37-39). "[W]hile some or all of the digermane gas and the HCl/HBr and HF additives can also be introduced in the plasma stream, these components of the cleaning process stream are

introduced as downstream non-plasma gases" (col. 11, lines 40-44). Moslehi directs the "nonplasma cleaning process gas stream into the afterglow of the plasma discharge inside the process chamber" (col. 12, lines 1-3). The inert gas plasma streams "interact with the non-plasma injected gas molecules, exciting them and causing process activation" (col. 11, lines 62-65).

Moslehi does not teach mixing a nonplasma gas flow with a flow of reactive radicals to form a gas-radical mixture anterior to the chamber. Instead, Moslehi discloses either introducing digermane gas and additives with inert gases in a remote plasma stream through the plasma gas tube (24) into the chamber, or using an inert gas plasma through the plasma gas tube (24) to excite downstream non-plasma digermane gas and additives introduced via the nonplasma gas manifold (22) into the afterglow of the plasma discharge of the plasma gas tube (24) in the chamber . There is no mixing of a flow of reactive radicals and a nonplasma gas flow anterior of the chamber.

For at least the foregoing reasons, claims 1-15 and 21 are novel and patentable over Moslehi.

Claims 16-20 Are Patentable over Kawamura or Moslehi in view of Stevens et al.

Claims 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawamura or Moslehi in view of Stevens et al. (U.S. Patent No. 5,302,803).

Applicants respectfully assert that claims 16-20 are patentable over the cited references because, for instance, they fail to disclose or suggest a mixing manifold and a pump system to create a nonplasma diluent gas flow and a flow of the reactive radicals to the mixing manifold to combine the diluent gas flow and the flow of the reactive radicals to form a gas-radical mixture egressing from the outlet of the mixing manifold and traversing through the intake port of the chamber, as recited in claim 16 from which claims 17-20 depend.

As discussed above, Kawamura does not teach a mixing manifold for mixing a nonplasma diluent gas flow and a flow of reactive radicals, but discloses separately flowing activated species of NF_3/H_2 first and then an Ar gas into the chamber. Moslehi also fails to disclose the recited mixing manifold. In Moslehi, the inert gases and digermane gas and additives are either injected in the remote plasma stream, or the inert gases are injected in the remote plasma stream into the chamber and the digermane gas and additives are introduced

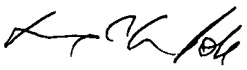
into the chamber separately as downstream non-plasma gases. Stevens et al. merely discloses a microwave plasma apparatus, and does not supply the teachings missing from Kawamura and Moslehi.

For at least the foregoing reasons, Applicants respectfully submit that claims 16-20 are patentable over the cited references.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is urged. If the Examiner believes a telephone conference would aid in the prosecution of this case in any way, please call the undersigned at 650-326-2400.

Respectfully submitted,



Chun-Pok Leung
Reg. No. 41,405

TOWNSEND and TOWNSEND and CREW LLP
Tel: (415) 576-0200
Fax: (415) 576-0300
RL
PA 3066626 v1